

Microwave Extraction of Water from Boreholes in Regolith, Phase I

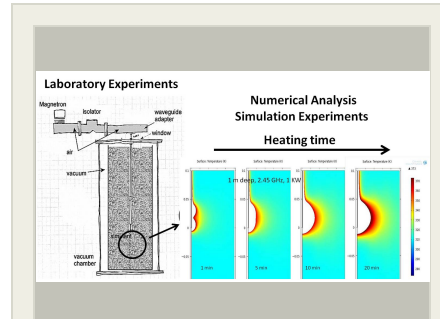
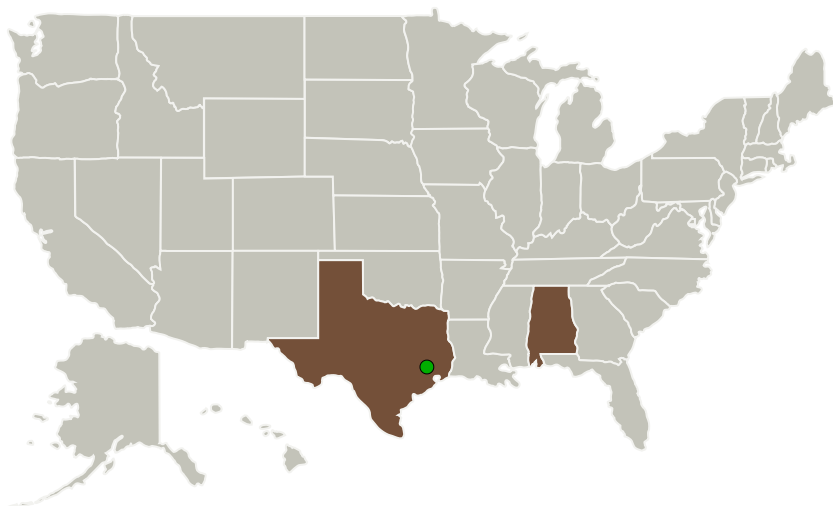
Completed Technology Project (2015 - 2015)



Project Introduction

Space Resources Extraction Technology, Inc. is developing and testing microwave technology for extracting water (along with other volatiles) from planetary permafrost. This in-space water will be used for human habitation, radiation protection, and to produce in-space rocket propellant. Utilization of In-space resources will save the high launch costs and higher costs to deliver payloads to other planetary surfaces. To greatly reduce Earth launch mass, propellant to return from the Martian surface will be manufactured with in-situ resources (i.e. water, CO₂) on the surface of Mars for manned exploration missions. A microwave probe can penetrate deep below the surface and extract water (vapor) below water depleted layers near the surface and where water ice is more concentration. We will test the efficiency of water extraction radiating microwave energy with our microwave probes in simulated Martian permafrost simulant under vacuum (i.e. 5 torr). We have shown that microwaves will penetrate regolith, heating in-situ. As the regolith heats, water ice sublimates to water vapor that will flow out of the regolith and can be funneled through a conduit in the probe to a remote cold trap. Microwave water extraction has been demonstrated in our lab by beaming microwaves with a microwave horn. We will validate that the process works with microwave probes and water extraction rates will be measured. It is a simple vapor transport process, efficient, less complex, and a lower mass method for volatiles prospecting and water mining. The process will eliminate the need for excavation and associated mining equipment, it can save the mass/costs to deliver excavation, mining and regolith handling equipment to Mars as well as the Moon. This method would reduce the cost/mass that has to be delivered to the moon (\$1M/kg) and Mars (\$10M/kg).

Primary U.S. Work Locations and Key Partners

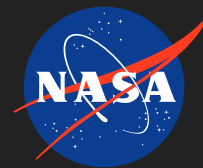


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Organizations Performing Work	Role	Type	Location
Space Resources Extraction Technology	Lead Organization	Industry	Huntsville, Alabama
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations

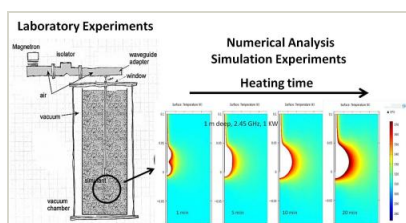
Alabama	Texas
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Project Transitions

**June 2015:** Project Start**December 2015:** Closed out**Closeout Summary:** Microwave Extraction of Water from Boreholes in Regolith, Phase I Project Image**Closeout Documentation:**

- Final Summary Chart Image(<https://techport.nasa.gov/file/139227>)

Images

**Briefing Chart Image**

Microwave Extraction of Water from Boreholes in Regolith, Phase I
(<https://techport.nasa.gov/image/128094>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Space Resources Extraction Technology

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

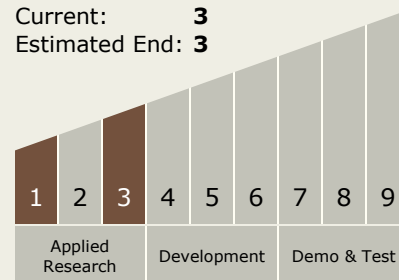
Program Manager:

Carlos Torrez

Principal Investigator:

Edwin C Ethridge

Technology Maturity (TRL)

Start: **1**Current: **3**Estimated End: **3**

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Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - └ TX07.1 In-Situ Resource Utilization
 - └ TX07.1.2 Resource Acquisition, Isolation, and Preparation

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System